

REALIZING THE POTENTIAL OF OUR DISCOVERIES AND PROTECTING NEW RESOURCES

INCREASED *knowledge and information about marine environments and resources are of great benefit to people the world over.*

Ocean explorers have a moral, if not legal, obligation to share information about important natural and cultural marine resources with all entities having responsibility for governance of the identified areas. Doing so will promote sound resource stewardship for the benefit of current and future generations.

Restoring and Protecting Ocean Resources

There is growing evidence that marine ecosystems have been severely impacted by human activities, most notably the exploitation of living resources. Because of typically strong food-web linkages,

the depletion of target species can have ecosystem-level impacts. Marine Protected Areas (MPAs) are widely regarded as one of the more effective means of protecting and restoring these systems to environmentally sustainable levels. MPAs can also serve to protect marine resources for their intrinsic values, and to maintain the numerous life-support systems and ecosystem services that our oceans provide. Increasingly, countries around the world are identifying marine resources and marine areas of particular concern that deserve special protection. American exploration activities can result in discoveries and the collection of information that can be used in decision-making relative to MPAs throughout the world. To achieve

this purpose, however, the information must be collected and disseminated to the appropriate decision-making entities in a timely and effective manner.

Although numerous MPAs already exist, nearly all of them are very small and restricted to shallow coastal areas. Thus, a number of fundamental questions remain to be answered relative to establishing and managing an effective system of MPAs: 1) What are the goals and purposes of establishing Marine Protected Areas? 2) How large must they be? 3) How many should there be? 4) Where should they be located? 5) What tools (i.e., the ways and means) are necessary to

effectively manage them? Information gathered by exploration can help answer these questions.

It is reasonable to expect that information about significant natural and cultural resources discovered anywhere in the global ocean in the course of exploration supported or sanctioned by the United States will be passed on to the MPA Center called for by the President in Executive Order 13158. This information should also be passed on to the appropriate country or international entity for use in making informed decisions about establishing new or expanding existing MPAs throughout the world.

To ensure that such information is made available to the MPA Center, protocols should be developed and adopted relating to collecting, documenting,

storing, accessing and disseminating data.

The President should assign leadership to an appropriate federal entity, and create a broad-based task force to implement this portion of the ocean exploration strategy. Representatives should come from affected federal agencies, (e.g., state resource agencies), academia and the non governmental ocean exploration community.

While the culture of information sharing among marine scientists is evolving, more should be done to promote accessibility to data, including data that is proprietary and classified. After an integrated, workable and comprehensive information processing system is established, steps must be taken to ensure that the system is implemented, monitored for effectiveness and reliability, and modified, as necessary, based on experience.

Implementation should include appropriate

institutional arrangements and agreements that are binding and that have leadership support within the respective agencies. In addition, appropriate levels of new funding necessary to sustain the effort should support the information-sharing system.

Because Marine Protected Areas often involve prohibitions against the extraction of resources (e.g., fish and minerals) and other uses (e.g., individual watercraft, mineral prospecting), their designations are controversial and often challenged in court. A major exploration initiative focused initially on the U.S. EEZ that is designed to gather information useful to marine resource managers, would be invaluable in carrying out the President's Executive Order calling for the expansion of a national system of MPAs. To be

useful to resource managers, the data collected must be of a type, scale and quality that can be applied to management decision-making in a timely and effective manner, so that it can help promote public support and that can withstand legal scrutiny.

Ocean Resources with Commercial Potential

Mankind has benefited tremendously from the relatively small historic investment in ocean exploration. Multichannel seismic mapping of the ocean sub bottom during the 1970s accelerated deep-water oil and gas exploration. During the past two decades, a renewed interest in marine bioprospecting has led to the discovery of thousands of unique products from marine plants, animals, and microbes, with commercial appli-

cations such as pharmaceuticals, nutritional supplements, cosmetics, enzymes, pigments, and fine chemicals. What is remarkable is that the discovery of these thousands of chemicals has come from exploring only a few coastal, and even fewer deep ocean, environments.

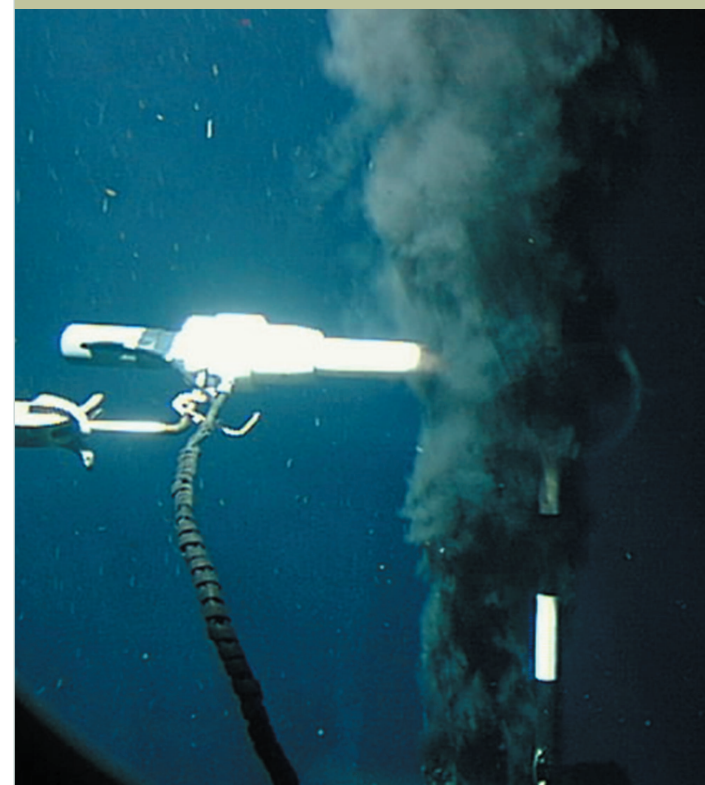
We have barely begun to tap the potential of the world's oceans to yield useful chemicals.

While many fisheries are over exploited, the search continues for environmentally sustainable fisheries to feed our ever-increasing global population.

Recent discoveries of gas hydrates, and the unique fauna that live in, on, or because of them, suggest that clean energy for America's future needs may lie within our own unexplored waters. Finally, citizens are eager to share in the exploration of our rich heritage of maritime history, unique archaeological sites, and exotic flora and fauna.

VENTS

The key to understanding the effects of deep ocean volcanism and hydrothermal venting requires voyages of exploration in the time domain. Frequent, in-situ observations, sustained for long periods of time, give scientists information that a snapshot view cannot provide. NOAA's VENTS Program is pursuing this strategy using a wide variety of sensors at seafloor observatories at venting sites. VENTS researchers conduct field operations for at least two months every year at observatories such as the NEw Millenium Observatory (NeMO) at Juan de Fuca Ridge, using research vessels, submersibles and remotely operated vehicles.



EXAMPLES OF COMMERCIALLY AVAILABLE MARINE BIOPRODUCTS

PRODUCT	APPLICATION	ORIGINAL SOURCE
Ara-A	antiviral drug	marine sponge (from U.S. coastal waters)
Ara-C	anticancer drug	marine sponge (from U.S. coastal waters)
Okadaic acid	molecular probe for biomedical research	marine microalga
Manoalide	molecular probe for biomedical research	marine sponge
Vent™ DNA polymerase enzyme	polymerase chain reaction	deep sea hydrothermal vent bacterium
Formulaid® (Martek Biosciences)	fatty acids used as additive in infant formula, nutritional supplement	marine microalga
Aequorin Green Fluorescent Protein (GFP)	bioluminescent calcium, indicator reporter gene	bioluminescent jellyfish
Phycoerythrin	conjugated antibodies used in ELISAs and flow cytometry	red algae
Resilience® (Estee Lauder)	"marine extract," an ingredient in skin care products	Caribbean gorgonian (sea fan)

Exploring the world's oceans and discovering new resources, both living and non living, will lead scientists to further evaluate the potential of these resources to be developed into useful products to benefit mankind. Ensuring the identification and subsequent research and development of these discoveries is a necessary follow-up to exploration. Thus, important components of a U.S. Ocean Exploration Program will be the support of research by:

— *Enhancing funding initiatives within federal agencies to support early-phase research on discoveries with commercial potential. Identifying the commercial potential of both living and non living resources will require a multidisciplinary,*

coordinated, and integrated approach to exploration. Newly discovered plants, animals, microbes, and minerals must be analyzed using state-of-the-art technology to determine their usefulness as pharmaceuticals, nutritional supplements, and fine chemicals for research and industrial applications. Relevant federal agencies must ensure support for early-phase research by establishing new programs specifically targeted for research on discoveries from the Ocean Exploration Program. In addition to the programs that currently exist to support short-term, high-risk research on the living and non living "products" of exploration, federal agencies need to emphasize, prioritize, and fast-track research initiatives on the "products" of the Ocean Exploration Program.

— *Providing incentives (such as tax credits, grants, and favorable licensing terms) to private industry to encourage the funding of research and develop-*

ment of discoveries with commercial potential. Private-sector involvement is critical. Although mechanisms exist to support and encourage partnerships between industry, academia, and government (e.g., Small Business Innovation Research [SBIR] and Small Technology Transfer Research [STTR] programs), these programs are not oriented to support the early-phase research that is necessary to identify discoveries with commercial potential. Incentives should be provided to industrial sponsors of high-risk, early-phase, research who are willing to support research directly or through ancillary program support. These incentives should include, but not be limited to, tax credits, grants, and favorable licensing terms. Special attention should be given to incentives for ocean industries to provide platforms for data gathering (e.g., offshore oil/gas platforms, seismic vessels, drill ships) during routine operations and during windows of opportunity for dedicated data gathering during ocean

transits (e.g., mobilization and demobilization from remote areas).

- *Promoting stakeholder support of research on the environmentally sustainable use of marine resources. Finally, and most important, it is recognized that along with identifying marine resources with commercial potential comes the obligation to protect such resources from over exploitation. Developers of products that require the extraction of resources should be strongly encouraged to support research on the potential for biological removal of living resources, including stock assessment, rates of growth and reproduction, and environmental sustainability of the resource and its habitat. The Panel endorses a precautionary approach to minimize the likelihood of detrimental effects. In most cases, taking from wild populations will not be a viable option to supply the development and marketing of marine bioproducts. Therefore, as a follow-up to exploration, both federal agencies and private-sector stakeholders must support research on the environmentally sustainable use of marine resources, including, but not limited to, bulk supply options such as aquaculture, microbial*

fermentation, chemical synthesis, and transgenic production.

RECOMMENDATIONS

The President can ensure that the knowledge gained from ocean exploration is effectively made available to ensure informed decision-making relative to Marine Protected Areas by:

- *Assigning leadership in this activity to an appropriate federal agency.*
- *Establishing a broad-based task force to design and implement an integrated, workable, and comprehensive data management, information processing system for all information, including unique and significant features.*
- *Enhancing funding within federal agencies to support early-phase research on discoveries with commercial potential.*

- *Providing incentives to private industry to encourage the funding of research and development of discoveries with commercial potential. U.S. laws should be reexamined to provide proper incentives for potential commercial users of ocean discoveries.*

- *Designing mechanisms whereby those who directly profit from the exploitation of marine resources support research on their environmentally sustainable use.*



OCEAN EXPLORATION DIRECTIVE

The White House
Office of the Press Secretary

June 12, 2000

Memorandum for:
The Secretary of Commerce

Subject:
A New Era of Ocean Exploration

Two years ago, the Vice President and I joined you, other members of my Cabinet, and hundreds of others from across the country at the National Ocean Conference in Monterey. This historic gathering drew together for the first time representatives from government, industry, and the scientific and conservation communities to begin charting a common oceans agenda for the 21st century.

At the Conference, I directed my Cabinet to report back with recommendations for a coordinated, disciplined, long-term federal ocean policy. In its report to me last year, *Turning to the Sea: America's Ocean Future*, the Cabinet outlined an ambitious and detailed strategy to ensure the protection and sustainable use of our ocean resources. I am proud of the actions my Administration is taking to begin implementing this strategy, including the Executive Order I issued last month to strengthen our national network of marine protected areas.

One of the Cabinet's key recommendations was that the Federal Government establish a national strategy to expand exploration of the oceans. Although we have learned more about our oceans in the past 25 years than during any other period in history, over 95 percent of the underwater world is still unknown and unseen. What remains to be explored may hold clues to the origins of life on Earth, cures for human diseases, answers to how to achieve sustainable use of our oceans, links to our maritime history, and information to protect the endangered species of the sea.

Today, I am announcing steps to immediately enhance our ocean exploration efforts and to develop the long-term exploration strategy recommended by you and the rest of the Cabinet. Together, these actions represent the start of a new era of ocean exploration.

First, I am announcing the launch of three new expeditions off the Atlantic, Gulf, and Pacific coasts. As you know, these expeditions, led by the Department of Commerce in collaboration with private partners, will allow the first detailed exploration of the Hudson River Canyon off New York, the Middle

Grounds and Big Bend areas off central Florida, and the Davidson Seamount off central California. Researchers will employ the latest submersible technologies and will share their discoveries with schoolchildren and the public via the Internet and satellite communications.

Second, to ensure that these new expeditions are only the start of a new era of ocean exploration, I am directing you to convene a panel of leading ocean explorers, educators, and scientists and to report back to me within 120 days with recommendations for a National oceans exploration strategy. In implementing this directive, you shall consult with the National Science Foundation, the National Aeronautics and Space Administration, the Department of the Interior, the Environmental Protection Agency, and other agencies, as appropriate. The strategy should consider the full array of benefits that our oceans provide, and should support our efforts to conserve and ensure the sustainable use of valuable ocean resources. Specifically, the strategy should:

1 |

Define objectives and priorities to guide ocean exploration, including the identification of key sites of scientific, historic, and cultural importance;

2 |

Recommend ways of creating new partnerships to draw on the tools and talents of educational, research, private-sector, and government organizations, including opportunities for federal agencies to provide in-kind support for private ocean exploration initiatives;

3 |

Examine the potential for new technologies — including manned and unmanned vehicles and undersea platforms — to observe and explore the oceans from surface to seafloor and recommend ways to explore the oceans remotely using new observatories and sensors and other innovative uses of technology; and

Recommend mechanisms to ensure that information about newly explored areas warranting additional protection is referred to the newly established Marine Protected Area Center, and that newly discovered organisms or other resources with medicinal or commercial potential are identified for possible research and development.

In the early years of the 19th century, President Thomas Jefferson commissioned Captain Meriwether Lewis to explore the American West. What followed was the most important exploration in this country's history. As America prepares to celebrate the 200th anniversary of the Lewis and Clark Expedition, we have an opportunity to set our sights on a much broader horizon. The time has come to take exploration farther west, and east, and south, to our submerged continents. In so doing, we can challenge and rekindle American's spirit of exploration, open up a whole new underwater world of possibilities, and help preserve our extraordinary marine heritage for future generations.

William J. Clinton

MARINE PROTECTED AREAS

EXECUTIVE ORDER

THE WHITE HOUSE
Office of the Press Secretary

May 26, 2000

EXECUTIVE ORDER:
Marine Protected Areas

By the authority vested in me as President by the Constitution and the laws of the United States of America and in furtherance of the purposes of the National Marine Sanctuaries Act (16 U.S.C. 1431 et seq.), National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-ee), National Park Service Organic Act (16 U.S.C. 1 et seq.), National Historic Preservation Act (16 U.S.C. 470 et seq.), Wilderness Act (16 U.S.C. 1131 et seq.), Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.), Coastal Zone Management Act (16 U.S.C. 1451 et seq.), Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), Marine Mammal Protection Act (16 U.S.C. 1362 et seq.), Clean Water Act of 1977 (33 U.S.C. 1251 et seq.), National Environmental Policy Act, as amended (42 U.S.C. 4321 et seq.), Outer Continental Shelf Lands Act (42 U.S.C. 1331 et seq.), and other pertinent statutes, it is ordered as follows:

Section 1. Purpose. This Executive Order will help protect the significant natural and cultural resources within the marine environment for the benefit of present and future generations by strengthening and expanding the Nation's system of marine protected areas (MPAs). An expanded and strengthened comprehensive system of marine protected areas throughout the marine environment would enhance the conservation of our Nation's natural and cultural marine heritage and the ecologically and economically sustainable use of the marine environment for future generations. To this end, the purpose of this order is to, consistent with domestic and international law (a) strengthen the management, protection, and conservation of existing marine protected areas and establish new or expanded MPAs; (b) develop a scientifically based, comprehensive national system of MPAs representing diverse U.S. marine ecosystems, and the Nation's natural and cultural resources; and (c) avoid causing harm to MPAs through federally conducted, approved, or funded activities.

Section 2. Definitions. For the purposes of this order: (a) "Marine protected area" means any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein. (b) "Marine environment" means those areas of coastal and ocean waters, the Great Lakes and their

connecting waters, and submerged lands thereunder, over which the United States exercises jurisdiction, consistent with international law. (c) The term “United States” includes the several States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands of the United States, American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands.

Section 3. MPA Establishment, Protection, and Management. Each Federal agency whose authorities provide for the establishment or management of MPAs shall take appropriate actions to enhance or expand protection of existing MPAs and establish or recommend, as appropriate, new MPAs. Agencies implementing this section shall consult with the agencies identified in subsection 4(a) of this order, consistent with existing requirements.

Section 4. National System of MPAs. (a) To the extent permitted by law and subject to the availability of appropriations, the Department of Commerce and the Department of the Interior, in consultation with the Department of Defense, the Department of State, the United States Agency for International Development, the Department of Transportation, the Environmental Protection Agency, the National Science Foundation, and other pertinent Federal agencies shall develop a national system of MPAs. They shall coordinate and share information, tools, and strategies, and provide guidance to enable and encourage the use of the following in the exercise of each agency’s respective authorities to further enhance and expand protection of existing MPAs and to establish or recommend new MPAs, as appropriate:

- (1) science-based identification and prioritization of natural and cultural resources for additional protection;
- (2) integrated assessments of ecological linkages among MPAs, including ecological reserves in which consumptive uses of resources are prohibited, to provide synergistic benefits;
- (3) a biological assessment of the minimum area where consumptive uses would be prohibited that is necessary to preserve representative habitats in different geographic areas of the marine environment;

(4) an assessment of threats and gaps in levels of protection currently afforded to natural and cultural resources, as appropriate;

(5) practical, science-based criteria and protocols for monitoring and evaluating the effectiveness of MPAs;

(6) identification of emerging threats and user conflicts affecting MPAs and appropriate, practical, and equitable management solutions, including effective enforcement strategies, to eliminate or reduce such threats and conflicts;

(7) assessment of the economic effects of the preferred management solutions; and

(8) identification of opportunities to improve linkages with, and technical assistance to, international marine protected area programs.

(b) In carrying out the requirements of section 4 of this order, the Department of Commerce and the Department of the Interior shall consult with those States that contain portions of the marine environment, the Commonwealth of Puerto Rico, the Virgin Islands of the United States, American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands, tribes, Regional Fishery Management Councils, and other entities, as appropriate, to promote coordination of Federal, State, territorial, and tribal actions to establish and manage MPAs.

(c) In carrying out the requirements of this section, the Department of Commerce and the Department of the Interior shall seek the expert advice and recommendations of non-Federal scientists, resource managers, and other interested persons and organizations through a Marine Protected Area Federal Advisory Committee. The Committee shall be established by the Department of Commerce.

(d) The Secretary of Commerce and the Secretary of the Interior shall establish and jointly manage a Web site for information on MPAs and Federal agency reports required by this order. They shall

Section 6. Accountability. Each Federal agency that is required to take actions under this order shall prepare and make public annually a concise description of actions taken by it in the previous year to implement the order, including a description of written comments by any person or organization stating that the agency has not complied with this order and a response to such comments by the agency.

Section 7. International Law. Federal agencies taking actions pursuant to this Executive Order must act in accordance with international law and with Presidential Proclamation 5928 of December 27, 1988, on the Territorial Sea of the United States of America, Presidential Proclamation 5030 of March 10, 1983, on the Exclusive Economic Zone of the United States of America, and Presidential Proclamation 7219 of September 2, 1999, on the Contiguous Zone of the United States.

Section 8. General. (a) Nothing in this order shall be construed as altering existing authorities regarding the establishment of Federal MPAs in areas of the marine environment subject to the jurisdiction and control of States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands of the United States, American Samoa, Guam, the Commonwealth of the Northern Mariana Islands, and Indian tribes. (b) This order does not diminish, affect, or abrogate Indian treaty rights or United States trust responsibilities to Indian tribes. (c) This order does not create any right or benefit, substantive or procedural, enforceable in law or equity by a party against the United States, its agencies, its officers, or any person.

William J. Clinton

REMARKS TO THE OCEAN EXPLORATION PANEL

Secretary of Commerce, Norman Y. Mineta

Ocean Exploration Panel Meeting

August 21, 2000

Good morning fellow explorers! I say fellow explorers because I believe that each and every one of us is an explorer at heart. You just had the good sense to make it your life's work! As space explorers observed over 30 years ago, Earth is a blue planet, an ocean planet. And just as those early explorers set the nation's commitment to space exploration, it is up to us today to build a foundation for a renewed commitment to ocean exploration.

On June 12, President Clinton directed the Secretary of Commerce to put together a panel of America's finest explorers, scientists and educators. He wanted the best people to work on a very, very important task: to develop a national strategy for ocean exploration. I thank each of you for responding to the call. Whenever we explore new frontiers — from the American west to outer space — we reap multiple benefits — to our economy, our technology, our health and our culture. And, as we embark on this new era of ocean exploration, we can envision extraordinary benefits. For example, the economic potential of America's unexplored oceans is vast. Gas hydrates may hold more than 1000 times the fuel in all other estimated oil and gas sources combined. Already one new anti-cancer medicine (called Bryostatins) comes from a marine sponge. This drug is estimated to have an annual market value of over \$1.2 billion. And there is more history under the sea than in all the museums of the world. The ocean is home for treasures of antiquity, sunken vessels and the legacy of our maritime past. And we have taken steps to protect this heritage.

The first national marine sanctuary protects the remains of the Civil War ironclad *USS Monitor*. The newest marine sanctuary — the Thunder Bay National Marine Sanctuary — will protect a collection of shipwrecks in Lake Huron. It's been said, rightly, I believe that we only protect that which we understand. By setting out on voyages of exploration and discovery, we build a foundation for conservation.

Technology is already bringing once inaccessible areas of the ocean within reach of fishermen, miners, and bio-prospectors. In some ways, we are playing catch-up to these advances. But, as we have learned

on land, protection must go hand in hand with exploration. Deep ocean exploration presents huge technological challenges. And as we have seen with space exploration, the solutions often have broad benefits.

In turn, we will bring back discoveries of new life forms, geological features and chemical processes. Unraveling their mysteries will spur new developments. In the days of Lewis and Clark, Americans waited months to learn about their discoveries. Today, through Internet and satellite communications, you can take us along. As many of you have shown, students and teachers can share in the excitement of planning and undertaking an expedition.

As President Clinton noted in calling for a new era of ocean exploration, America needs a sustained investment to reap the full benefits for society. Exploration is not partisan, nor is it the exclusive domain of any agency. It requires the full participation of government and the private sector. And, above all, a successful ocean exploration strategy must engage the public. A truly successful report will give us a strategy to make all citizens explorers — and move ocean issues beyond this esteemed panel here today. The effort to reach out and bring the excitement of these endeavors into America's classrooms is one of the best investments we can make. It is often said that children are natural scientists. This great exploration endeavor has the potential to spark and nurture that curiosity through film, television, and the Internet. But let's also remember the adults out there — remember to reach out to the explorer in all of us.

Ask yourself: Where were you when man first walked on the moon? That amazing event remains so vivid in our minds because all Americans, indeed the world, were able to see it live on TV. That day inspired a whole new generation of explorers.

How will Americans be able to join you on your expeditions to new ocean frontiers? Will today's

explorations inspire the next generation of ocean scientists — and at home explorers? An ocean exploration strategy that reaches its full potential must tap all the expertise and resources available to us. The exploration of the world's oceans cannot be accomplished by one government agency, nor can it be accomplished by government alone.

I urge you, in your deliberations, to envision a new collaboration among governments, academia, and the private industry that reaches out to everyone. In addition, a successful ocean exploration strategy should explore through time. Voyages to remote places are essential, but so are those that occur through time as well. The establishment of networks, observatories, and data arrays on the seafloor and in the ocean's water column often reveals more to science than a snapshot approach ever will.

Two hundred years after Lewis and Clark forever changed the American landscape, you can chart a new course to explore the American seascape. My hope is that, with public outreach, future generations will view this commission as a turning point for exploration of the oceans. Thank you all for your willingness to be part of this critical task for our future. I eagerly await your report. May it mark a new era of ocean exploration and conservation — a new era of stewardship for the oceans.

Norman Y. Mineta

AGENCY SUMMARIES

OF OCEAN EXPLORATION ACTIVITIES

Environmental Protection Agency (EPA)

The EPA's mission is to protect and restore the environmental quality of ocean ecosystems. A priority must be established for the exploration of coastal ecosystems because they are particularly threatened by pollution, coastal development, and overexploitation of resources. These stressors can cause habitat loss, nuisance algal blooms, hypoxia, toxic contamination of marine life, and ecological degradation. Although coastal systems are the most easily accessible to study, our understanding of how they are structured and how they function is still not well established.

To ensure that we manage these systems in a sustainable manner, we must understand them. We should explore coastal ecosystems with new and efficient measurement techniques to establish baselines for status and trends and to allow us to interpret the causes and consequences of

change. We must ensure that exploration and discovery of the resources in the oceans do not lead to overexploitation and degradation of these same resources, as they often have in the past.

National Aeronautics and Space Administration (NASA)

NASA is one of the earth science discovery agencies of the federal government. Scientific exploration of the Earth is an essential step in understanding weather, climate and natural hazards. It may also assist in the quest for the origins of life. NASA's mission in the area of ocean exploration is to support the migration of ocean observing techniques from research to operational use, conduct and preserve high-quality, long-term, systematic measurements of the oceans, facilitate data exchange and real-time assimilation within an integrated ocean observing system, and increase public awareness of the critical role the oceans play in our lives on Earth.

To achieve this mission, NASA conducts ocean-observing missions that reveal the new and unforeseen phenomena in Earth's oceans. NASA also develops enabling technology for ocean observing missions throughout the solar system, and contributes to the development of an integrated ocean observing system. NASA also conducts research missions that explore techniques for ocean observation, including new satellite technologies and sensors for ocean remote sensing, in-situ ocean sensors made ready for space environments and vice versa, and creating or refining ocean circulation models.

NASA explores the practical application of its discoveries in ocean science through several partnerships and programs, including the U.S. Global Climate Research Program (USGCRP), National Ocean Partnership Program (NOPP), Integrated Global Observing Strategy (IGOS), and NASA's Seasonal-to-Interannual Prediction Program (NSIPP).

National Science Foundation (NSF)

The National Science Foundation is a primary player in ocean exploration and discovery. NSF supports disciplinary and interdisciplinary research efforts and the means, particularly ships and other equipment, necessary to access the oceans from the surface to deep in the sea floor.

Core programs include investigator-initiated research in biology, chemistry, physical oceanography, and marine geology and geophysics, including research within polar regions. Focused programs include Continental Margins (MARGINS), Life in Extreme Environments (LEn), Ecology of Harmful Algal Blooms (ECOHAB), Coastal Ocean Processes (CoOP), Environmental Geochemistry and Biogeochemistry (EGB), World Ocean Circulation Experiment (WOCE), U.S. Joint Global Ocean Flux Study (JGOFS), Ridge Interdisciplinary Global Experiments (RIDGE), Global Ocean Ecosystems

Dynamics (GLOBEC), Marine Aspects of Earth System History (ESH), Surface Heat Budget of the Arctic Ocean (SHEBA), Science Ice Exercise (SCICEX), and Shelf-basin Interactions in the Arctic (SBIA). Integrating research and education is a high priority for NSF.

NSF provides significant support to facilities and technologies that enable access to various regions of the ocean and ensure effective research and communication capabilities. NSF is the primary supporter of numerous surface vessels, including the academic research fleet (consisting of 28 ships of various sizes), polar vessels, and icebreakers. NSF is also a major supporter of manned submersible activities. Other support includes both the technological development and emplacement of seafloor observatories, remotely operated vehicles, autonomous underwater vehicles, and other instrumentation such as communications technology. Finally, the Ocean

Drilling Program, supported by NSF in concert with numerous international partners, enables access to the Earth's undersea crust by drilling into the sea floor to recover rocks and sediment.

United States Department of Commerce, National Oceanic and Atmospheric Administration (NOAA)

Exploration is the first step in understanding Earth's environment, undertaking wise stewardship of resources, and understanding ecosystem functioning. NOAA's mission in this area includes finding new resources, bioprospecting materials from exotic species, inspecting new life forms, investigating gas hydrates and associated ecosystems, and exploring mineral-rich geologic deposits. Additionally, NOAA is charged with protecting, developing, and conserving poorly understood resources, including unexplored fisheries, their habitats and ecosystems, deep

corals and live bottoms, and our cultural heritage, which encompasses shipwrecks and submerged cultural resources. In addition, NOAA's ocean management programs, such as the National Marine Sanctuary System, seek to fill large gaps in our fundamental understanding of coastal and ocean phenomena through use of exploration technologies and programs. NOAA is also seeking to understand ocean noise, both natural sound levels and human-induced noise, and their effects on marine animals. The organization also works toward developing technologies to support exploration, which will facilitate access to remote, difficult environments, surface to sub-sea floor, and long-term observations and sampling of the biota and environment. NOAA's mission also includes a mandate to conduct education and outreach activities to build an ocean constituency and educate the public on ocean issues. The three most prominent ocean exploration programs currently housed at NOAA are the National Undersea

Research Program, the Sustainable Seas Expeditions, and the VENTS Program. NOAA is also hoping to introduce an Ocean Exploration Initiative for FY 2002, which would support discovering new resources, understanding ocean sound, exploring frontier areas, protecting America's maritime heritage, education and outreach activities, as well as data management activities. NOAA strongly supports the concept of a Census of Marine Life, and technology development to improve fish stock assessments.

United States Department of Interior, Minerals Management Service (MMS)

The MMS, a bureau of the U.S. Department of the Interior, is this nation's manager of mineral resources on and under the sea bed of the outer continental shelf (OCS). The bureau has a two-fold mission: 1) Collect, verify and distribute mineral royalties from tribal and federal offshore

and onshore lands and ensure a fair return to the American public; and 2) Manage the oil and gas and other mineral resources of the OCS in a safe and environmentally sound manner.

In order to meet its environmental and safety responsibilities, the MMS conducts environmental and engineering research to provide information for management decisions on all phases of mineral resource development activities on the OCS. This research is focused to meet management needs for informed decision making. Environmental research is conducted through the Environmental Studies Program, which has been funded at \$19.5 million per year for the past several years. Scientists from academic and research institutions, the private sector, state agencies and other federal agencies conduct virtually all of MMS's research. The MMS has formal research partnerships, called "Coastal Marine Institutes," with Louisiana State University,

the University of Alaska at Fairbanks, and the University of California at Santa Barbara.

While MMS research is directed to specific information needs for OCS mineral management purposes, some of that research has been exploratory in nature and has led to major scientific discoveries. Some examples are: discovery of chemosynthetic communities and species in the Gulf of Mexico; initial understanding of noise impacts on marine mammals; better understanding of three-dimensional water circulation on the shelf and slope; and knowledge about the migration patterns of several species of endangered whales via satellite telemetry.

Extensive MMS research efforts in the 1970s and 1980s led to the discovery and classification of numerous new species of benthic invertebrates from the OCS.

Beginning in FY 2001, MMS will initiate a marine biotechnology effort. Specifically the bureau,

working through its California and Louisiana Coastal Marine Institutes, will conduct research on the taxonomic and genetic biodiversity found on offshore oil and gas platforms, and analyze selected taxa for bioactive compounds that may have pharmaceutical and other commercial applications. Other research initiatives are the intensive investigation of the physical oceanography and benthic ecology of the deep water (water depths greater than 350 meters) Gulf of Mexico, and continued field investigations of the impacts of human-induced noise on marine mammals.

United States Department of Energy (DOE)

Ocean exploration to DOE is the search for energy resources in the ocean's coastal zones and continental shelf. Offshore oil and gas production has been an integral part of domestic and global energy supply for more than 30 years.

That contribution has been made possible by a vast investment in the knowledge, technology, and infrastructure needed for production at steadily increasing water depth. With the continuing decline in our domestic onshore oil production and the projected increase in natural gas use, the economic, safe, and environmentally benign production of oil and gas resources in deep- and ultra-deep water will be even more important. To achieve that goal, DOE will partner with other agencies, industry, academia, the national laboratories, and other stakeholders in developing the knowledge and technologies needed. DOE will also be seeking an understanding of the role the oceans play in the Earth's carbon cycle, and how this understanding can contribute to climate change. DOE has also been given the lead responsibility for an interagency program on methane hydrates — ice-like structures containing methane — which are estimated to have a resource potential exceeding that of all other

fossil resources. Understanding the nature and behavior of hydrates and their possible impacts on deep-water oil and gas production and climate change, as well as determining whether their contained methane can be economically and safely produced, will be important elements in our understanding of the ocean and its resources.

United States Navy

With the ocean critical to our national security and its primary operating environment, the Navy plays a key role in federal ocean programs. The Office of Naval Research supports ocean exploration as part of its discovery and invention program. The Oceanographer of the Navy is responsible for all operational oceanography in the Navy, including advanced research and development to support it. Ocean exploration is often an outcome and benefit of systematic in-situ and remote data collection activities that the Navy undertakes to map the ocean bottom and

diagnose its structure and behavior in support of military operations. Science and exploitation are often built upon such ocean survey results.

Navy niches in such partnership efforts include technology, data management, operational oceanography, cutting-edge science, and the opportunity for pure discovery.

United States Geological Survey (USGS)

Maps, in the broadest sense, are one of the most valuable products of exploration. The mapping of the deep EEZ through the mid-1980s showed that systematic mapping can be carried out on a large scale. The value of a systematic and phased effort was also demonstrated. Detailed seafloor maps invariably expose new features and provide evidence of unknown processes. As map coverage expands, the variety and large-scale structure of the seafloor is revealed. Subsequent develop-

ments have enabled high-resolution mapping in shallow waters. Results from the shallow shelf are no less exciting and no less surprising. Mapping is only one facet of exploration, but a critical one that returns a picture of the previously unknown and guides further exploration.

OCEAN EXPLORATION PANEL PROCESS

On June 12, 2000, the President directed the Secretary of Commerce to convene a panel of leading ocean explorers, scientists, and educators to recommend a national ocean exploration strategy. The responsibility for convening the panel of experts within 120 days was delegated to the National Oceanic and Atmospheric Administration (NOAA), within the U.S. Department of Commerce. At the request of the Undersecretary for Oceans and Atmosphere, Dr. D. James Baker, the NOAA Science Advisory Board (SAB) selected the panel of experts, and specifically designated the Chair of the Panel. Technical experts within the federal government were added to the Panel in an advisory capacity.

The Ocean Exploration Panel was designated as a working group of the NOAA SAB, a federal

advisory committee. The 23-member Panel met twice. At the first meeting in Washington, D.C., on August 22-23, 2000, they reviewed current ocean exploration activities presented by government agencies, industry, and non-profit organization representatives. Following this meeting, the Panel drafted their report. A notice of the meeting was published in the Federal Register and public input was solicited. The Panel met again on September 14-15, 2000, in Monterey, California, to review progress on the report. The Panel's work on this report was completed through the extensive use of e-mail following the meeting in Monterey. To consult with various federal agencies during this process, an Interagency Task Force was created. NOAA, NASA, DOE, EPA, USGS, MMS, NSF and the Navy were represented on this Task Force. NOAA provided all necessary administrative and logistical support to the Panel

to carry out this assignment. Information and points of contact were provided throughout the process on a public website maintained by NOAA.

ACKNOWLEDGEMENTS



Norman Y. Mineta
Secretary of Commerce

The Secretary of Commerce, Norman Y. Mineta, wishes to acknowledge the work of Dr. Marcia McNutt and the Ocean Exploration Panel. The Panel maintained a rigorous schedule to create this report within a mandated 120-day period. Additionally, the hard work of the Science Advisors to the Panel assured that this report will meet the needs of a community of ocean technology and scientific experts.

The Secretary also wishes to thank Marcia Collie, Claire Johnson, Michael Kelly, Christine Maloy, Barbara Moore, and Pam Rubin, the NOAA support team whose hard work and dedication produced this document and organized the working of the Panel.

For further information, contact:
NOAA Public Affairs
202.482.6090 or 301.713.2483

For additional copies of this report, contact:
U.S. Department of Commerce
National Oceanic and Atmospheric Administration
Office of Constituent and Public Affairs
14th and Constitution Ave., N.W.
Washington, DC 20230
202.482.6090

CREDITS / DESCRIPTIONS

Photographs and Illustrations

Cover

Kerby, Terry. National Undersea Research Program/University of Hawaii

Page 8

Map of Lamont Core distribution. Columbia University's Lamont-Doherty Earth Observatory

Page 11

Deployment of a scientific device from an oceanographic vessel that tests the Conductivity, Temperature, and Density of water (also known as a CTD).

Page 13

Map of the sixth largest impact crater on Earth found about 200 km south of Washington, D.C.
United States Geological Survey

Page 14

Multibeam sonar images permits in-depth characterization and mapping of the sea floor. United States Geological Survey

Page 16 (top)

Ice worms are the only known animal to inhabit gas hydrates on the seafloor. National Undersea Research Program

Page 16 (bottom)

Map provided courtesy of the National Geographic Society © NGS

Page 19

Education and outreach captivates students, educators, and the general public. Wilder, Randy © Monterey Bay Aquarium

Page 21 (top left)

The *Alvin* submersible. Woods Hole Oceanographic Institution © WHOI

Page 21 (top center)

The head of a statue in basalt representing a Pharaoh, which had been found during excavation of an archaeological site.
Gerigk, Christoph © Hilti Foundation/Franck Goddio/ Discovery Channel

Page 21 (top right)

A rendezvous between the *DeepWorker 2000* submersible and the *Atlantis* passenger submarine off the coast of Hawaii during the January 2000 Sustainable Seas Expeditions. Evans, Kip F./National Geographic Society © NGS

Page 22

Future scenario of global ocean exploration grid. U.S. Navy

Page 23 (left)

Oceanographic vessel at sea.

Page 23 (right)

Dense patch of sponges found at Davidson Seamount. Monterey Bay Aquarium Research Institute © 2000 MBARI

Page 28 (left)

Vibrant Christmas tree worms. National Oceanic and Atmospheric Administration

Page 28 (center)

Vampyroteuthis infernalis, vampire squid. Reisenbichler, Kim/Monterey Bay Aquarium Research Institute ©1996 MBARI

Page 28 (right)

Polyorchis pencillatus, midwater jelly. Raskoff, Kevin/Monterey Bay Aquarium Research Institute ©1998 MBARI

Page 30

The Jason XII Expedition to Hawaii 2001 logo: A Living Laboratory. © The Jason Project

Page 32

A diver examining a marine archaeological artifact. Gergk, Christoph © Hilti Foundation/Franck Goddio/Discovery Channel

Page 36 (top)

Three seagliders aboard the *R/V Miller* in Puget Sound, WA. Seagliders are small remotely controlled autonomous vehicle that repeatedly glide down and up through the ocean as they measure temperature, salinity, current, oxygen, chlorophyll, and other properties. They are designed to dive as deep as 2 km, operate for many months, and travel as far as a quarter of the way around the world. Woods Hole Oceanographic Institution © WHOI

Page 36 (bottom)

The Autonomous Benthic Explorer known as ABE. Woods Hole Oceanographic Institution © WHOI

Page 37

Compilation of hydrophone sites for passive underwater acoustics. Fox, Chris/National Oceanic and Atmospheric Administration

Page 38

Woods Hole Oceanographic Institution © WHOI

Page 42

The *Alvin* submersible with microchemical sensor in manipulator at a hydrothermal vent. Woods Hole Oceanographic Institution © WHOI

Page 44

A molecular biologist refines probes for detecting toxic algae. Leet, M. Monterey Bay Aquarium Research Institute © 1997 MBARI



U.S. DEPARTMENT OF COMMERCE / NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION